

NIA Graduate Research Assistantship Opportunity In High-Performance Computing

The National Institute of Aerospace (NIA) has an opening for graduate students in a broadly defined area of exascale and general high-performance computing for NASA applications. High-performance computing (HPC) plays a critical role in NASA's science, engineering, and operations. It supports all phases of NASA activity from formulation of hypothesis to conceptual design to analysis to mission operations. In aeronautics, HPC is vital not only to NASA's own technology, but to NASA's mission of supporting and enhancing the competitiveness of the US civil aircraft manufacturing industry. The most advanced supercomputing capabilities at NASA are currently measured in petaflops (10^{15} operations per second). It is projected that these capabilities will reach the level of exascale performance (10^{18} operations per second) sometime in the next decade.

Novel scalable scientific algorithms are needed to enable NASA's key applications to exploit the computational power of massive-scale systems. This is especially true for the current tier of leading petascale machines and the road to exascale computing as HPC systems continue to scale up. These systems require novel scientific algorithms to hide network and memory latency, achieve very high computation-to-communication ratios, and minimize synchronization. Scientific algorithms must be fault-tolerant, as the probability of component failure increases with scale and cannot be neglected. With the advent of heterogeneous computer nodes that employ a broad range of processing units, scientific algorithms must be specifically designed and implemented to leverage the strengths of these architectures in order to maximize performance. Key NASA applications require novel mathematical models and system software that address the scalability and resilience challenges of current and future-generation extreme-scale HPC systems.

As HPC continues to play an ever-larger role in today's science and engineering disciplines, a broad range of research avenues is available. It is envisioned that the selected candidates will conduct a leading-edge research program that will advance the state of the art in fluid dynamics computations on extreme-scale HPC systems to benefit NASA applications. Examples of research topics include optimization of both new and existing computational paradigms on emergent heterogeneous architectures, which may be composed of some combination of traditional CPUs, GPGPUs, MICs, ARMs, etc. Software development based on the use of high-level programming languages and auto-tuning to abstract the fundamental concepts of an algorithm, while improving portability of the software across systems with widely-varying hardware architectures are of interest. Advanced algorithms that drastically increase the ratios of flops/memory access and flops/communication are needed. Fault-tolerant schemes capable of recovering from isolated system failures will be essential. Acceleration of computations based on the use of field-programmable gate array (FPGA) architectures is also of interest. Other areas of research related to HPC systems may also be considered.

For this position, the selected candidates will have to be admitted to a graduate program at one of NIA member universities: Georgia Tech, Hampton University, North Carolina A&T State University, North Carolina State University, the University of Maryland, the University of Virginia, Virginia Tech, Old Dominion University, and the College of William & Mary. The students will be supported by an NIA Graduate Research Assistantship, which includes a stipend of \$22,000-26,000 per year, covers all tuition and fees, covers university health insurance and includes a \$1500 per year travel allotment. The students will reside at NASA Langley Research Center in Hampton, Virginia for the duration of their studies. US citizenship or Permanent Residency (Green Card) is a bona fide requirement. Research will be supervised by NASA and NIA mentors in collaboration with a home university faculty, who will serve as the academic advisor. The position is available Spring Semester 2014 and applicants should apply by September 30, 2013.

To apply, interested candidates should e-mail a statement of intent and a copy of their resume to Mrs. Mary-Catherine Bunde, NIA Education & Outreach Administrator (e-mail: mary.bunde@nianet.org, ph.: 757-325-6731).